Energy Optimization through clustering in Wireless Sensor Networks

SHORT SYNOPSIS

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Certificate

I hereby declare that the short synopsis "Title: Energy Optimization through clustering in Wireless Sensor Networks" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Computer Science & Engineering under faculty of Engineering & Technology of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2018- 2019.

It is a bona fide record of original work carried out under the supervision of Dr Supriya Panda and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

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ABSTRACT

Wireless Sensor Network (WSN) is a collection of small electromechanical nodes termed as sensors. Sensors are equipped with sensing unit, which is designed for application specific. Sensors can be deployed either by planned (predefined location) or unplanned (random location). After deployment, sensors are challenged with limited battery power. After deployment, sensor nodes start depleting their energy in various roles as sensing, communication, aggregation etc. It is proven fact that communication is the biggest reason of energy consumption. So it becomes essential to reduce energy consumption on communication. The aim is to use available energy in efficient manner to maintain sustainability in networks. Various energy efficient techniques have been proposed to improve network lifetime.

Clustering plays a very important role to reduce communication energy requirements. Clustering employs that only cluster heads will participate for communicating aggregated information to far located base station. There are various existing energy efficient clustering protocols that improve the network lifetime. Challenge comes when cluster heads are managing both roles as heads as well as relay nodes. The role of relay nodes is required for aggregating and communicating their own cluster's data as well as other data received from other relay nodes due to multi hop communication. The thought of relay nodes will be incorporated in clustering protocols to further prolong the lifetime of network. This will reduce the burden on cluster head and will improve the sustainability of network

Key words: — *Wireless Sensor Networks; Sensor Nodes; Clustering Protocol; Energy efficient Networks; Cluster Head; Base station; Relay Nodes; Network lifetime; Multi hop communication; Energy optimization.*

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1 Introduction

WSN is formed of tiny electromechanical devices called sensors. Sensors are small powered devices mainly deployed over a region to monitor particular phenomena like temperature, pressure, humidity etc. They sense parameters, convert them into signals and there after communicate information through wireless medium. Base station is the point, which gathers and understands the received signals. These Signals can further be converted in to human understandable form and communicated over a network for further analysis.

1.1 Design of WSN

Sensor is an electromechanical device constituted by sensing entity, communication part (which may be a radio transceiver with antenna), a tiny processor, which is known as microcontroller, and a power battery (Oliveira, L.M. and Rodrigues, J.J, 2011). Sensors are capable of sensing, data analyzing and communicating the information. The task of sensing, analyzing and communication is performed by sensing entity, processor and communication part respectively (Oliveira, L.M. and Rodrigues, J.J, 2011). Architecture details of a sensor node are shown in Figure 1.

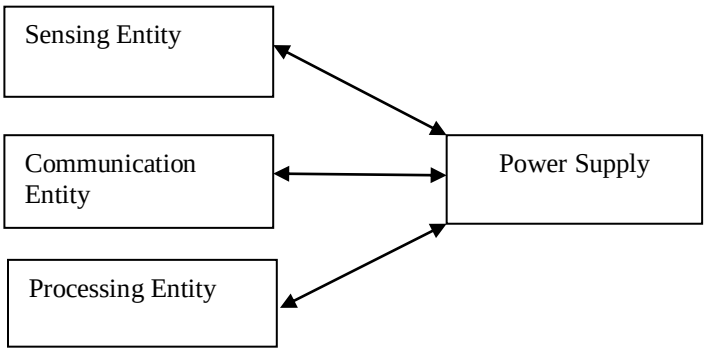

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Figure 1. Architecture of a Sensor Node

Nodes are packed unit of microcontroller, transceiver, power unit and battery (Oliveira, L.M. and Rodrigues, J.J, 2011). Microcontrollers are like a tiny computer. Sensor uses microcontroller, which has pins in the range of 8 to128. It usually runs on 3.3 to 5 Volts and can work with frequency of 8 to 20 MHz. They have 256 bytes of RAM, which is dependent on manufactures and on applications. Transceiver is used for communication between nodes and base station. Their two major functions are transmitting and receiving. Transmission media is usually RF signals, however license free range of communication 173, 433, 868, and 915 MHz and 2.4 GHz can also be used.

1.2 Classification of WSN

Wireless Sensor Network (WSN) can be classified on different categories. Here is a survey of different types of sensor networks as shown in Figure 2.

A. Homogeneous or Heterogeneous WSN

Homogeneous networks have all nodes of similar types. All nodes have same battery time, memory capacity, communication capabilities, sensing and computation power. Nodes with equal capabilities and resources are deployed over the region and duties are distributed amongst them without any priorities. On the other hand, heterogeneous networks have different types of nodes on region of deployment. Some nodes have extra capabilities like more computation power, more memory or more energy. These sensor nodes are arranged in the same region and duties are distributed among them as per their priorities (Mhatre, V. and Rosenberg, C., 2004). These special nodes are deployed in planned manner to hand over some extra responsibilities over them.

B. Proactive or Reactive WSN

Sensor nodes from proactive sensor networks remain active all the time and keep on sensing on regular basis. They send data to base station on intervals. On the other hand reactive networks send information only when some unusual event happens. Sensor nodes keep sensing but transmit only when they detect any variation in regular phenomena. Proactive sensor nodes have shorter lifespan as compared to Reactive networks.

C. Structured or Unstructured WSN

On the basis of infrastructure, WSNs can be categorized as structured or unstructured. Generally in unstructured WSN, deployment of huge number of sensor nodes is done without any strategy or we can also say in ad hoc manner. These sensor nodes operate in an unattended environment (Yick, J., Mukherjee, B. and Ghosal, D., 2008). These networks are tough to maintain and to satisfy Quality of Services (QoS) because there is no assurance of connectivity and failure detection is near to impossible. On the other hand, sensors in Structured WSNs are deployed in a pre-defined manner. Deployments are planned in engineered way to satisfy and meet network requirements. Their maintenance is easy and cheap in comparison of unstructured WSNs. Structured wireless sensor network offers optimal coverage even with small number of nodes whereas unstructured Wireless Sensor Networks may still have some uncovered regions.

D. Terrestrial WSN

Terrestrial WSN (TWSN) is made up of thousands of nodes generally deployed in a fixed region for monitoring purpose. Monitoring can be done in surveillance field where army needed for security or can be in hospitals, forests etc. Infrastructure of TWSN can be structured or unstructured. In TWSNs, sensors are of fixed battery power and are non rechargeable; some researchers also proposed solar cell to charge batteries of sensor nodes. Energy conservation techniques can also be used in terrestrial networks. Sensor nodes can maintain low duty cycle operation, can perform aggregation and can use clustering etc.

E. Underground WSN

Underground WSN (UgWSN) is termed when deployment of nodes is in caves, mines or below ground. These networks are designed to sense underground conditions and their base station or relay nodes can also be on ground. Generally these networks are deployed in planned manner and are properly structured. Underground networks are usually expensive due to high cost of deployment; their maintenance cost is also very high as compared to that of terrestrial networks (Li, M. and Liu, Y., 2007). The biggest challenge for these networks is to maintain QoS in communication because of more attenuation in signals and to be reliable in transmission through soil, water and other present minerals. Battery life is also a point of concern here, as it's not possible to charge batteries or to substitute them.

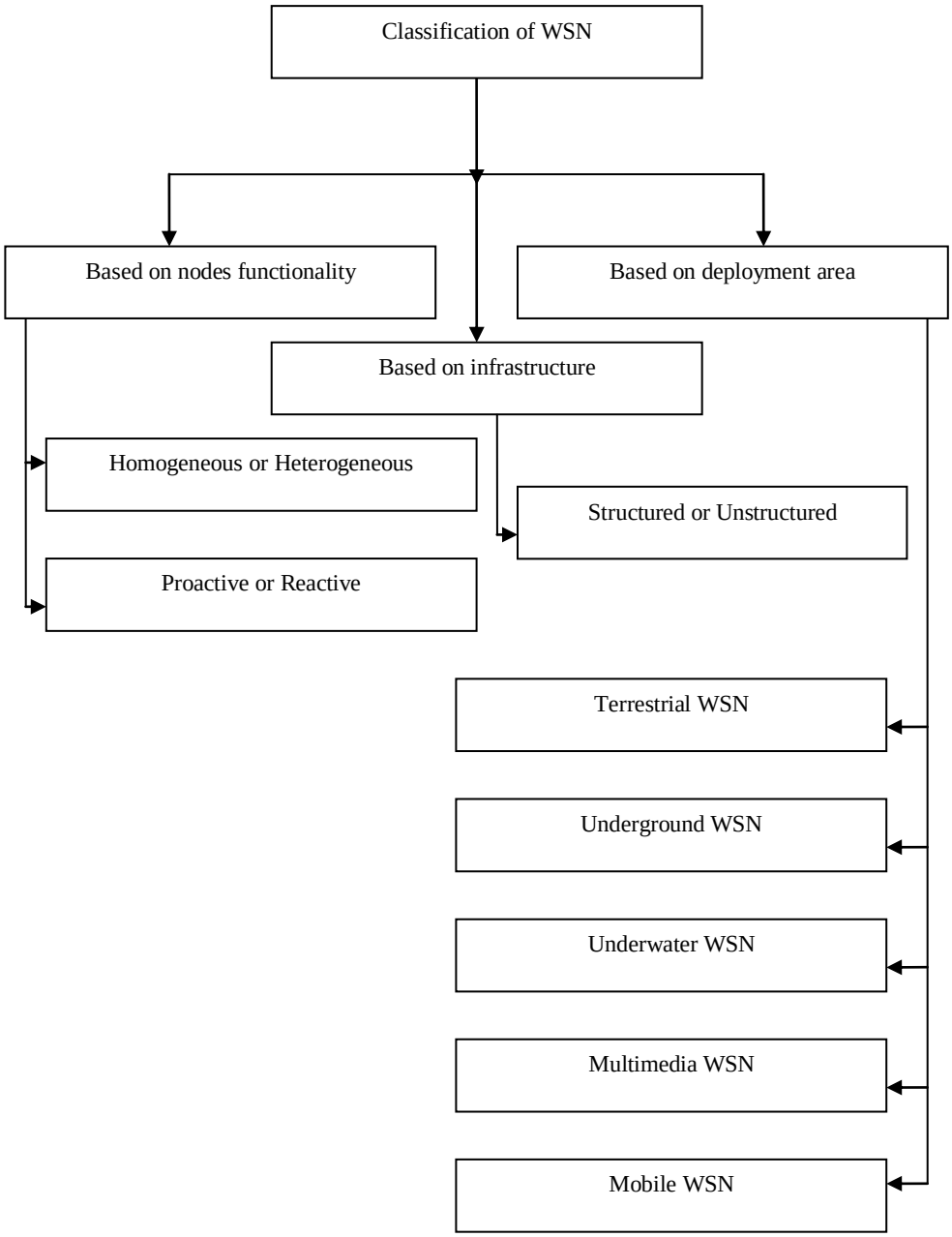

Figure 2. Classification of WSN

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F. Underwater WSN

In Underwater Wireless Sensor Network (UwWSN) deployment of sensors nodes are done in water environment (Akyildiz, I.F. and Stuntebeck, E.P., 2006). Sometimes may be under oceans along with sovereign underwater transport. Deployment of sensors in underwater environment is very much expensive. Transmission media in underwater wireless sensor Networks is acoustic waves which generally posses some inadequacy like limited bandwidth, high propagation delay and large attenuation. Underwater nodes must ensure properties like self-configuration and adaptability in harsh conditions of underwater environment as failure ratio is higher in underwater sensor networks.

G. Multimedia WSN

Multimedia WSN (MWSN) is composed of nodes that monitor information as multimedia contents like video, audio and images from environment. Nodes in these networks are equipped with microphones and cameras (Akyildiz, I.F., Melodia, T. and Chowdhury, K.R., 2007). MWSNs usually consist of small number of nodes due to expensive nature of nodes. As huge bandwidth is required for multimedia contents like videos, Wireless Sensor Networks must ensure huge bandwidth, high quality contents, high energy, processing and compression of large amount of data. Due to varying amount of delay and channel capacity, it is always a challenge in multimedia for WSN to guarantee high quality of contents. However, for reliable transmission of data, certain level of quality must be ensured. In order to enhance the performance of network, techniques like aggregation, compression and filtering are used, which minimize superfluous information and merging of similar information.

H. Mobile WSN

Mobile WSN (MoWSN) is constituted by nodes which are mobile in nature and gather information from the environment. Mobile nodes have the complete characteristics of static nodes like sense, compute and communicate. However, their capability of being mobile and rearrange themselves in network differentiate them from static nodes (Yick, J., Mukherjee, B. and Ghosal, D., 2008). Mobile Wireless Sensor Network commence with initial deployment of

nodes. Later on, nodes start relocating themselves over the network to gather information. Mobile nodes also have the characteristics to exchange information with each other whenever they come in communication range. Distribution of data is another feature that differentiates mobile sensor nodes from the other nodes. Mobile networks use dynamic routing in contrast to Static networks which use fixed routing. Navigation, deployment, maintenance, coverage, energy dissipation and self-organization are some of the key challenges which are being faced by the mobile wireless networks. Mobile Wireless Sensor Networks have applications like Environment surveillance, target tracking and real-time monitoring of affected areas in case of disasters.

1.3 **Applications of WSN**

Wireless Sensor Network has wide range of application areas broadly, which are:

A. Environmental applications
    i. Fire detection
    ii. Flood detection
    iii. Disaster management
    iv. Pollution detection
B. Military applications
    i. Monitoring
    ii. Targeting and Reconnaissance
    iii. Attack detection
C. Health applications
    i. In-body bio-monitoring
    ii. Monitoring patient's physiological parameters
    iii. Tele-monitoring of human physiological data

D. Industry Specific applications

i. Inventory control and management

1.4 Challenges in Wireless Sensor Network

i. Small Node Size- Sensor node size must be restricted.
ii. Low Node Cost-Network establishment cost should be low to satisfy the application need.
iii. Low Power Consumption- Power consumption should be optimized so that network could survive for longer period of time.
iv. Self Configurability- Network should be able to reconfigure itself in the anomalous situations.
v. Scalability- Network should be adequate to enhancement.
vi. Application Specific- Network must satisfy the specific requirement of application
vii. Fault Tolerance-Network should be able to heal itself.
viii. Security-Network should be secure from outside world.
ix. Channel Utilization-Network should utilize medium appropriately.
x. QoS Support-Network should insure quality of service.

1.5 Energy Optimization in WSN

Sensor nodes in WSN can be deployed either in planned or unplanned manner. Once Sensors are deployed their energy start depleting on sensing, communication, aggregating etc. They are challenged with limited battery power (Khan, J.A., Qureshi, H.K. and Iqbal, A., 2015). Communication is considered as one of the biggest reason of energy consumption. It's necessary to use the available energy in efficient manner to maintain sustainability in networks. Following are the various energy optimizing techniques which prolong the lifetime of network.

A. Digital Signal Processor(DSP)

Energy optimization is a key challenge for researcher in WSN; (Wang, A. and Chandrakasan, A., 2002) has proposed digital signal processor for energy efficiency in wireless

sensor networks. Paper basically emphasizes on designing of energy efficient WSNs. Authors have proposed that a low-power DSP can perform local analysis on sensor data in a wireless communication networks. Various applications of micro sensors network like warehouse inventory tracking, patient monitoring and location tracking etc. have also been discussed by the author. This paper has discussed one of the applications that use micro sensor, and has transmission media as acoustic waves for environmental monitoring. These sensors are very much adaptable in nature. Further, the paper has also presented the concept of clustering in WSN. Clustering is the grouping of sensors that reduces power dissipation. Authors had also proposed the idea to reduce the storage requirement by efficient networking protocols, and local signal processing.

B. 2D Gaussian distribution

Wang, D., Xie, B. and Agrawal, D.P. (2008) have triumphed over the challenge of sensing coverage and also emphasized on battery power constraint. Authors surveyed that battery power constraints in WSN can affect Coverage and can also have impact on lifetime. The authors have proposed a structure using 2D Gaussian distribution which has enhanced sensing coverage and also improved the lifetime of a WSN. Paper has assessed Gaussian dispersion on different dimensions to study sensing coverage and lifetime of network. Authors admitted different Gaussian parameters but followed uniform distribution. Intrinsic properties of coverage/lifetime of WSN with various Gaussian distribution parameters are studied and results are obtained. To enhance the lifetime of network, authors have further proposed various sensor deployment strategies. Authors have proposed two algorithms for sensor deployment, which could increase network lifetime. These deployment strategies give optimal solution and have complexity in polynomial time. Enhanced network life is one of the key challenges in WSN, the research work has clearly shown that Gaussian distribution can improve lifetime of sensor networks.

C. Distributed algorithm using Lagrangian

He, Y., Lee, I. and Guan, L. (2009) have proposed one distributed algorithm in WSNs. Authors have proposed one approach , which optimizes source rates and uses best encoding powers to improve network lifetime. Authors have developed one Distributed algorithm using Lagrangian duality, which improves the life span of wireless visual sensor networks. The designed distributed algorithm achieves better network lifetime as compared to that of

conventional wireless sensor networks with maximization algorithm. Further , authors have given another contribution by providing the relationship between two factors, one of them is the video quality and the other one is to maximize lifetime of WVSNs, which plays vital role in designing of network.

D. Energy aware sensor design

Yan, R., Sun, H. and Qian, Y. (2013) have given Energy aware sensor design. Authors have presented a strategy for energy-efficiency, which reduces energy utilization at sensor node as well as at network level. They had designed sensor nodes with concept of sleep/awake that reduces energy consumptions. Sensor nodes use lowest transmission power after estimating the distance between the transmitter and the receiver. Furthermore, energy consumptions can also be reduced by choosing most energy efficient network configuration by estimating the total energy utilization within the network with respect to various network configurations.

2. Literature Review

Oliveira, L.M. and Rodrigues, J.J. (2011) have defined that WSN is constituted by large number of tiny ad-hoc sensor nodes with small processing, less storage, low power and sensing capabilities. Nodes are deployed over large area, monitor physical parameters like temperature, pressure, humidity and air quality. This paper has carried out the application of environment monitoring. Various Challenges for consideration in environmental monitoring are power management, scalability, usability and remote management.

Wei, D., Jin, Y., Vural, S., Moessner, K. and Tafazolli, R. (2011) have proposed a clustering protocol 'Energy-efficient Clustering' based on distribution clustering. A cluster size is determined based on distance of hop to data sink. Far cluster will have lesser nodes while nearby cluster may have more number of nodes. Cluster Head is selected on rotation basis. The main restraint is that this has not considered random and equal distribution of sensor deployment.

Liu, X. (2012) have defined that Limited energy resource is one of the key challenges in WSN and clustering method that helps to reduce power consumptions, which lead to improve the network lifetime of WSN. Clustering is grouping of nodes in WSN and selection of cluster Head (CH) for a group. Various clustering protocols like LEACH, HEEED, DWEHC, TEEN and EEUC are there. Various advantages of clustering are data aggregation, more scalability, load balancing, less energy consumption, more robustness etc. The challenge is to apply energy efficient protocols on real time applications.

Singh, Y. and Chugh, U. (2013) has proposed a Mutual Exclusive Distributive Clustering **(** MEDC), which works for cluster selection. MEDC works in four steps. Cluster head selection work is based on message exchange. Cluster heads will be rotated after every iteration. This has only considered random distribution. The challenge is to apply other distribution techniques for sensors deployment.

Tarhani, M., Kavian, Y.S. and Siavoshi, S. (2014) have proposed a new protocol that uses the concept of relay node. In conventional clustering algorithms cluster heads plays the roles of heads as well of relay nodes. In this protocol Cluster Head (CH) and relay nodes are selected separately. Relay nodes reduce the load of cluster heads by taking the responsibility of communication, which saves the energy of cluster head and prolongs the network lifetime. The key constraint of this paper is that it has not considered residual energy of node during cluster head selection.

Khan, J.A., Qureshi, H.K. and Iqbal, A. (2015) have described various energy provision and energy consumption taxonomy. Energy provision includes battery driven, harvesting and transference, while energy consumption includes data driven, duty-cycling and mobility based. Various efficient energy management methods for energy provision and energy consumption have also been specified. The key restraint is that it has not specified effective utilization of sensor node's energy.

Liu, X.Y., Zhu, Y., Kong, L., Liu, C., Gu, Y., Vasilakos, A.V. and Wu, M.Y. (2015) have described Data for WSN can be collected through two ways: raw data collection and aggregated data collection. Authors have proposed a data collection scheme that follows opportunistic routing with compression. This scheme reduces energy transmission cost and further leads to prolong network lifetime. The challenge is to apply non uniform estimator for multiple attributes scenario.

Arghavani, M., Esmaeili, Mohseni, F. and Arghavani, A. (2017) have defined energy efficient clustering in circular wireless sensor network where nodes are distributed evenly in circular area and sink is at the center. Cluster Head is selected through reservation based criterion. As nodes reserve their time slots to be the cluster head at the setup phase, so it decreases the message passing overhead and reduces energy consumption of network and prolong its lifetime. The challenge is to consider the different location of sink apart from center.

2.1 Gaps in study

i. Clustering is one of the vital energy efficient methods. There are numerous kinds of clustering protocol that selects cluster head through different means. Cluster head is always been burdened with the responsibility of data aggregation and communication. The overburden on cluster head abruptly affects its power resource and can lead to partitioning of network and can also influence network lifetime.

ii. Wireless sensor networks have incorporated the relay nodes by various methods. SEECH clustering protocol has used relay nodes and selection of the same is planned on the basis of its location. However the clustering protocols that account on the residual energy have overlooked the relay nodes to prolong the lifetime of randomly deployed sensor network.

iii. Most of clustering protocols have presumed that the sink (base station) is at the extreme positions of sensor nodes region. However some real time applications could have sink node at different locations, which can affect the lifetime of sensor network.

3. Description of Broad Area

Clustering is a grouping technique to reduce transmission cost and to enhance network life in WSNs. Cluster is a smaller divided area of the network, in each cluster a node is elected as group head (cluster head, CH). CH node collects gathered data from non CH nodes and is responsible to transfer the aggregated information. CH transfers aggregated information either to higher level cluster heads or directly to sink. The prime idea of clustering is to reduce the power utilization for communication which leads to save network life of sensors network (Liu, X., 2012). The additional advantages of clustering are loading balancing (Liu, X., 2012) less load, scalability, reduced latency, data aggregation etc. Clustering protocols can be categorized on various parameters like centralized and distributive (Liu, X., 2012). Other additional classification of clustering protocols is multilevel, multi-hop inter-cluster communication, power based and location aware.

In Centralized clustering, base station plays a vital role as it selects the cluster head among sensor nodes. Base station broadcasts the information of cluster head to sensor nodes. So there is no requirement of message passing between the nodes, which adds the benefit to centralized clustering. Base station is further responsible for timely cluster heads rotation as well (Wei, D., Jin, Y., Vural, S., Moessner, K. and Tafazolli, R., 2011). Example of these typed protocols is Low Energy Adaptive Clustering Hierarchy Centralized (LEACH-C) and SHORT etc. The requirement of high powered, proficient base station is the only disadvantage of centralized protocols. In distributed algorithms sensor nodes select cluster head on the basis of message passing between them. Rotation of Cluster head is performed after next cycle of protocol. LEACH, Energy Efficient Unequal Clustering (EEUC), and Distributive Hierarchical multilevel Agglomerative Clustering (DHAC), Mutual Exclusive Distributive Clustering (MEDC) and Mutual Exclusive Hybrid Energy efficient Distributive (MEHEED) etc. are some of the examples of Distributed protocols.

In Power base clustering algorithms, CH is chosen on the basis of residual battery life of sensor nodes. Sensor nodes with maximum residual energy will be elected as CH. Hybrid Energy Efficient Distributive (HEED) and Threshold Energy Efficient Sensor Network (TEEN) are some of the examples of some power based protocols. In Multi-hop inter cluster communication, sensor nodes send sensed data to CH through intermediate nodes. When sensor nodes send data straight to CH, it is named as single hop, on the contrary, in multi hop inter

cluster communication sensor nodes data is sent to CH via intermediate nodes. HEED, EEUC and HACH protocols make use of Multi-hop communication.

Location awareness in wireless nodes (WNs) is a feature wherein every sensor node is equipped with global positioning system (GPS) device. Sensors can find the location of other nodes with the help of GPS. Power Efficient Adaptive Clustering Hierarchy (PEACH) protocol and Optimal Clustering in Circular Network (OCCN) protocol use the feature of location awareness.

In multilevel clustering, there is a hierarchy of CHs i.e., CHs send information further to their heads of CHs known as super head. Feature wise summary of existing Clustering protocols is shown in Table 1.

Table 1: Clustering protocols

CLUSTERING PROTOCOLS	
Protocol	**Features**
LEACH Wei, D., Jin, Y., Vural, S., Moessner, K. and Tafazolli, R.(2011)	• Distributive • Probability based cluster heads selection • Perform data aggregation to reduce transmission cost
HEED Wei, D., Jin, Y., Vural, S., Moessner, K. and Tafazolli, R.(2011)	• Distributive • Multi hope Inter cluster communication • Residual Power Base cluster heads selection • Multilevel Clustering
LEACH-C Wei, D., Jin, Y., Vural, S., Moessner, K. and Tafazolli, R.(2011)	• Centralized • Location Aware sensors Wei et al. (2011) • Power Base cluster heads selection

TEEN Manjeshwar, A. and Agrawal, D.P.(2001)	• Distributive • Power Base cluster heads selection • Works for Reactive Networks
PEACH Yi, S., Heo, J., Cho, Y. and Hong, J. (2007)	• Distributive • Can works with both Location aware and Location unaware sensors • Probabilistic energy aware routing
SHORT Yang, Y., Wu, H.H. and Chen, H.H.(2006)	• Centralized • Chain Based Protocol
EEUC Lung, C.H. and Zhou, C. (2010)	• Distributive • Multi Hop Inter cluster communication • Unequal clusters
DHAC Chamam, A. and Pierre, S. (2010)	• Distributive • One Hop Communication • Clustering only once
EECF Chamam, A. and Pierre, S. (2010)	• Distributive • Multi Hop Inter cluster communication • Power Base cluster heads selection
PADCP Cheng, J.Y., Ruan, S.J., Cheng, R.G. and Hsu, T.T. (2006)	• Distributive • Multi Hop Inter cluster communication • Power Base cluster heads selection
MEDC Singh, Y. and Chugh, U.(2013)	• Distributive • Multi Hop Inter cluster communication • Power Base cluster heads(CH) selection

SEECH Tarhani, M., Kavian, Y.S. and Siavoshi, S.(2014)	• Distributive • Power Base cluster heads selection • Separate Relay Nodes
OCCN Arghavani, M., Esmaeili, M., Esmaeili, M., Mohseni, F. and Arghavani, A.(2017)	• Multi Hop Communication • Optimal sized clusters • Location Aware Sensors
HACH Oladimeji, M.O., Turkey, M. and Dudley, S.(2017)	• Works with both communication methods single hop and Multi Hop • Generic Algorithm for cluster head selection • Selected Nodes are put into sleep state
MEHEED Singh, Y. and Chugh, U.(2013)	• Distributive • Multi Hop Inter cluster communication • Both Probability based and Power Base cluster heads Selection

3.1 Problem Formulation

The wireless sensor network is consistently challenged with limited power resource. Various energy efficient techniques have been designed which minimize the energy utilization of sensor nodes in WSN. Clustering is one of the extensive energy efficient methods that prolongs the network lifetime. There are numerous kind of clustering protocols and their performance can be analyzed on the parameter of network lifetime. The concept of relay node can also be incorporated in clustering for further improvement. SEECH is one of the protocols that use the relay node concept in clustering. However this concept is not been used by any residual energy based clustering protocols. Aim of this research work would be to propose improvised MEDC (residual energy based) clustering protocol with relay node to prolong network lifetime of WSN. Further the work would be aimed to apply these proposed solutions for real time applications in wireless sensor networks.

4. **Objectives of the Study**

i. To review various types, applications and challenges of WSNs.

ii. To optimize energy utilization of sensors through clustering for improving the lifetime of WSNs.

iii. To analyze the performance of various existing clustering protocols on basis of network lifetime.

iv. To propose improvised MEDC clustering protocol with separate relay node to prolong network lifespan.

v. To apply proposed solutions for real time application in Wireless Sensor Networks.

5. **Methodology to be adopted**

Flow for the methodology to be adopted is shown in figure 3:

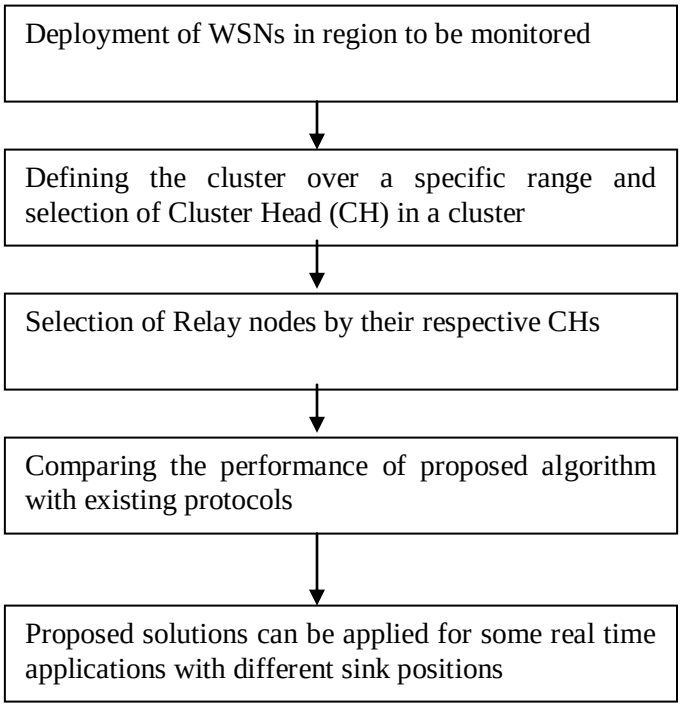
Deployment of WSNs in region to be monitored
Defining the cluster over a specific range and selection of Cluster Head (CH) in a cluster
Selection of Relay nodes by their respective CHs
Comparing the performance of proposed algorithm with existing protocols
Proposed solutions can be applied for some real time applications with different sink positions

Figure 3. flow for methodology

6. Expected Outcome of the Research

i. Effective utilization of energy by sensors would lead to improved Lifetime of WSNs.

ii. An Improved MEDC protocol with separate relay node will be implemented.

iii. These solutions would be applied for real time application in WSN.

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Energy Optimization through clustering in Wireless Sensor Networks

SHORT SYNOPSIS
by

Amit Chugh
16/Ph.D/027

Under the supervision of
Dr. Supriya P Panda

ABSTRACT

Wireless Sensor Network (WSN) is a collection of small electromechanical nodes termed as sensors. Sensors are equipped with sensing unit, which is designed for application specific. Sensors can be deployed either by planned (predefined location) or unplanned (random location). After deployment, sensors are challenged with limited battery power. After deployment, sensor nodes start depleting their energy in various roles as sensing, communication, aggregation etc. It is proven fact that communication is the biggest reason of energy consumption. So it becomes essential to reduce energy consumption on communication. The aim is to use available energy in efficient manner to maintain sustainability in networks. Various energy efficient techniques have been proposed to improve network lifetime.

Clustering plays a very important role to reduce communication energy requirements. Clustering employs that only cluster heads will participate for communicating aggregated information to far located base station. There are various existing energy efficient clustering protocols that improve the network lifetime. Challenge comes when cluster heads are managing both roles as heads as well as relay nodes. The role of relay nodes is required for aggregating and communicating their own cluster's data as well as other data received from other relay

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